

Application Number 10/531,367  
Amendment dated January 21, 2009  
Response to Office action of October 22, 2008

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**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

Claim 1 (currently amended): A tunnel barrier ~~for controlling the movement of electrons through a thermoelectric material~~ comprising a potential barrier having an indented or protruded cross-section, wherein the geometry of the indents in said indented cross section or of the protrusions in said protruded cross section is stepped, and wherein walls of said stepped geometry are perpendicular to one another[.] and wherein the depth of indents in said indented cross-section or the height of protrusions in said protruded cross-section is chosen to set a threshold energy corresponding to the energy of high energy free electrons, whereby said tunnel barrier is transparent to flow of high energy free electrons and blocks flow of average and low energy free electrons; whereby movement of electrons through a thermoelectric material is filtered.

Claim 2 (canceled):

Claim 3 (currently amended): The tunnel barrier of claim 1 wherein [[the]] said depth of indents in said indented cross-section or [[the]] said height of protrusions in said protruded cross-section is given by the relationship  $\lambda(1+2n)/4$ , where  $\lambda$  is the de Broglie wavelength of said high energy free electrons, and where  $n$  is 0 or a positive integer.

Claim 4 (original): The tunnel barrier of claim 3 in which  $n$  is an integer having a value between 0 and 4.

Claim 5 (canceled)

Claim 6 (original): The tunnel barrier of claim 1 in which said potential barrier comprises an electrical insulator.

Claim 7 (previously presented): A thermoelectric device comprising:

- a) a first thermoelectric material;
- b) a second thermoelectric material;

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c) one or more tunnel barriers of claim 1.

Claim 8 (previously presented): The thermoelectric device of claim 7 wherein said first thermoelectric material comprises an n-type material, said second thermoelectric material comprises a p-type material, and wherein a tunnel barrier of claim 1 is in electrical contact with an anode of said n-type material and a cathode of said p-type material.

Claim 9 (previously presented): The thermoelectric device of claim 7 wherein said first thermoelectric material comprises an n-type material, said second thermoelectric material comprises a p-type material in electrical contact with said n-type material, and wherein a tunnel barrier of claim 1 is in electrical contact with an anode of said p-type material.

Claim 10 (previously presented): The thermoelectric device of claim 7 wherein said first thermoelectric material comprises an n-type material, said second thermoelectric material comprises a p-type material, and wherein a tunnel barrier of claim 1 is in electrical contact with an anode of said n-type material and a further tunnel barrier of claim 1 is in electrical contact with an anode of said p-type material.

Claim 11 (previously presented): A method for making the thermoelectric device of claim 7 comprising:

- (a) forming an indented or protruded structure on a surface of a first thermoelectric material;
- (b) forming an electrically insulating material over said indented or protruded surface;
- (c) attaching a second thermoelectric material to said insulating material.

Claim 12 (original): The method of claim 11 in which said step of forming an insulating material comprises depositing said insulating material.

Claim 13 (original): The method of claim 11 in which said step of forming an insulating material comprises oxidising said first material.

Claim 14 (original): The method of claim 11 in which said step of forming an indented or protruded structure comprises etching.

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Claim 15 (original): The method of claim 11 in which said step of forming an indented or protruded structure comprises ablation.

Claim 16 (previously presented): The tunnel barrier of claim 1 wherein the depth of indents in said indented cross-section or the height of protrusions in said protruded cross-section is in the range  $10 - 100\lambda$ , where  $\lambda$  is the de Broglie wavelength of said electrons.

Claim 17 (previously presented): The tunnel barrier of claim 6 in which said electrical insulator is selected from the group consisting of:  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ ,  $\text{Al}_2\text{O}_3$  and titanium oxide.

Claim 18 (previously presented): The thermoelectric device of claim 7 in which said first or said second thermoelectric material is selected from the group consisting of:  $\text{Bi}_2\text{Te}_3$ , Sb-doped  $\text{Bi}_2\text{Te}_3$ , Se-doped  $\text{Bi}_2\text{Te}_3$ ,  $\text{Bi}_{1-x}\text{Sb}_x$ , and CoSb.

Claim 19 (previously presented): The method of claim 11 in which said insulator material is selected from the group consisting of:  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ ,  $\text{Al}_2\text{O}_3$  and titanium oxide.

Claim 20 (previously presented): The method of claim 11 in which said first or said second thermoelectric material is selected from the group consisting of:  $\text{Bi}_2\text{Te}_3$ , Sb-doped  $\text{Bi}_2\text{Te}_3$ , Se-doped  $\text{Bi}_2\text{Te}_3$ ,  $\text{Bi}_{1-x}\text{Sb}_x$ , and CoSb.